One such cure of the patient's mental disturbance is more than a balance against many failures. This is especially true where, in no instance in the experience of Manton or Picqué or myself, has the mental state of any patient been injured by the operations done.

RESEARCHES ON THE BLOOD OF EPILEPTICS.[1]

By B. Onuf, M.D.,

AND

Horace Lograsso, M.D.,

SONYEA, N. Y.

(From the Pathological Laboratory of the Craig Colony for Epileptics, Sonyea, N. Y.)

In such a disease or symptom-complex as epilepsy, the etiology of which is in many respects still very obscure, everything that may throw some new light on it is to be considered of value. While former investigations on this point concerned themselves chiefly with the condition of the brain, the metabolism of epileptics has of late years also received attention and a considerable number of investigations were made on the urine, gastric secretion, sweat, saliva, and blood of epileptics, treating the subject either with a view of establishing changes of metabolism in general or with the purpose of finding a basis to the theory of intoxication.

The blood of epileptics has been studied largely with regard to its toxic properties. On the other hand, the morphology of the blood—*i. e.*, the study of the formed elements of the blood—has so far been relatively neglected, very few researches existing in the literature in this field.

If it is considered how fruitful the study of the formed elements of the blood and particularly of the leukocytes has been for the understanding of many disease conditions, being a great help in the diagnosis of many of them, it seems justifiable and promising some return, to investigate their behavior in the epileptic, so as to establish some eventual further points in the complicated symptomatology of the disease and to possibly throw some new light on its etiology.

In reviewing the literature we here confine ourselves to the most important contributions, which we render in the briefest form possible so as not to take too much of your time.

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[1] Read before the New York State Medical Society, February 1, 1905.

We begin with the investigations of S. R. McPhail,[1] who studied a total of 25 cases, namely:

1st group, 5 epileptics just admitted.

2d group, 5 epileptics who had potassium bromide more than one and less than five years.

3d group, 5 epileptics who had potassium bromide more than five and less than ten years.

4th group, 5 epileptics who had potassium bromide more than ten and less than fifteen years.

5th group, 5 epileptics who had potassium bromide more than fifteen and less than twenty years.

The bromide dose in all these cases was 30 grains of the salt three times a day.

He found that on admission the hæmoglobin was considerably below the normal, averaging 72.8 per cent., with a minimum of 60 and a maximum of 80. The number of leukocytes was 20 per cent. below normal. Both then increased—*i. e.*, the blood improved under the bromide treatment administered at the asylum to all epileptics, and only after fifteen years of bromide treatment did slight deterioration take place.

Smith[2] examined in 50 cases of epilepsy the hæmoglobin percentage, the number of red blood cells, and the specific gravity of the blood plasm during seizures and in free intervals. In the free intervals he found the hæmoglobin percentage to range between 50 and 75, the average being $62\frac{23}{25}$. The red blood cells ranged between 3,200,000 and 5,650,000, the average being 4,520,000 per cubic millimetre. The specific gravity ranged between 1047 and 1070, averaging $1056\frac{43}{50}$.

Smith also paid attention to the proportion of red to white cells, to the granulations, etc., and found absolutely no constant variation from the normal. In a few instances there was an excess of white corpuscles over the normal number in health.

The study of the leukocytes in three criminal "Frenasthenics," 15 general paretics and 12 epileptics (8 men and 4 women), was made by Roncoroni,[3] who found that only the leukocytes with eosinophile granulations offered special interest, and he found these cells often diminished in epileptics, in some cases extremely so (3 per cubic millimetre).

Observations of the condition of the blood during epileptic seizures were made by Smith,[4] Féré,[5] and Pugh,[6] while Capps[7] studied the blood of general paretics. As Smith's investigations were concerned chiefly with the specific gravity of the blood we omit them. Féré[1] noticed in seizures an increase of the red cells, with which the hæmoglobin did not hold pace. He explained the increase of red cells by concentration of the blood through loss of fluid owing to secretions, especially of sweat, accompanying them, while the failure of the hæmoglobin of keeping pace with the relative increase of the red cells was explained by the destruction of oxyhæmoglobin by the "nervous discharge" of the seizure. Féré furthermore observed that many of the red cells assumed spherical shape and became smaller than the ordinary ones. Finally, he noticed an increase of the blood platelets to take place during epileptic seizures.

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[1] Clinical Observations on the Blood of the Insane, Journal of Mental Science, 1884, vol. xxx. p. 85.

[2] An Inquiry into the Blood and Urine of the Insane, ibid., 1890, vol. xxxvi. p. 504.

[3] Archivio di Psichiatria, Sciense penale e Autropologia criminale, 1894, vol. xv. p. 293.

[4] Loc. cit.

[5] Mémoires de la Société de biologie, 1889, sér. 9, tome i. p. 213.

[6] On Certain Blood Changes in Idiopathic Epilepsy, Brain, 1902, vol. xxv. p. 501.

[7] The Blood in General Paralysis, THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, June, 1896, vol. cxi. p. 650.

The research most approaching that of the writers in scope was that of Robert Pugh,[2] who in 20 cases made counts of the leukocytes during and after seizures, and in a few of them also in the intervals between seizures. He found in the interparoxysmal period a wide variation in the number of leukocytes. In some cases the leukocytes were found to drop some hours before a fit. They were the cases with frequent fits. In others, and they constituted the majority, there was a gradual drop right up to the paroxysm. In spite of a careful perusal of Pugh's paper, however, we fail to find evidence supporting the latter contention. Whatever figures the author may have in proof of his statement are not given in his paper.

In seizures Pugh found a distinct leukocytosis which showed itself a short time after the fit and attained its maximum from about fifty to seventy minutes after. He found the increase due to the large and small hyaline cells (by which he designates the large and small lymphocytes respectively). The eosinophile cells were increased two to ten hours after the seizure. The leukocytosis in status epilepticus was not so constant and was subjected to wide variations.

Of Capps'[3] investigations we only mention the interesting fact that in the convulsive seizures of the general paretic he also observed a leukocytosis which he says is as sudden as it is pronounced and certainly does not appear until a very short time preceding a convulsion, probably not before it actually takes place.

PERSONAL RESEARCH. The writers in taking up the study of the formed elements of the blood as a subject of research had the following purpose in view:

1. To establish in general—*i. e.*, in the periods of freedom from seizures—the condition of the formed elements of the blood.

2. To study the behavior of the formed elements in connection with epileptic seizures—*i. e.*, to determine the following points: (*a*) whether in seizures any changes in the composition of the blood

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[1] Loc. cit.

[2] Loc. cit.

[3] Loc. cit.

concerning its formed elements could be observed; (*b*) whether such changes if found were secondary—*i. e.*, caused by the attack itself; or (*c*) whether they were primary, having causal relation to the seizures themselves—in that case they ought to be found directly or shortly before the occurrence of a seizure and eventually even hours or days previous to one; or (*d*) whether they were simply side issues of the seizures—*i. e.*, having neither a causal relation to these nor being produced by them and being the reaction of some other, say toxic changes, the latter being on the other hand the real cause of the attacks.

To establish point 1—*i. e.*, the condition of the blood of epileptics in the free intervals—19 cases were selected, 8 men and 11 women, all of which had been without bromides for a period of at least two months preceding the examination, and all of which were idiopathic cases, so far as such idiopathy could be determined by an exclusion of the following factors:

I. A history of birth traumatism. However, the statement "prolonged labor" was considered too indefinite to cause exclusion unless accompanied by more specific data pointing to birth traumatism; for instance, asphyxia, convulsions, or coma.

II. Convulsions right after birth. (This group really comes under I.)

III. Eventually acute infectious diseases, if the epilepsy began within two months after the onset of the same, and continued right along. Where the epilepsy sets in at a later date the connection with the infectious disease becomes too uncertain, and such cases were therefore not excluded from idiopathy. Convulsions occurring in infancy during an infectious disease, and then followed by a free interval of years, did not justify exclusion.

IV. Traumatism of head, if there is a distinct connection between the onset of the epilepsy and such traumatism—*i. e.*, if the disease follows within a few days or weeks after such traumatism. Where the interval is one of months the connection becomes very doubtful. In case of a clear history of cerebral injury following head trauma—such as loss of consciousness, vomiting, symptoms of fracture of base of skull, etc.—such history was considered a sufficient cause of exclusion, even if the first epileptic seizure occurred months or years after the traumatism.

V. Cases presenting distinct evidence of organic disease of the nervous system, diffuse or focal—such as hydrocephalus, hemiplegia, monoplegia, multiple sclerosis, etc., including meningitis.

VI. Cases accompanied by conditions which so frequently cause organic changes of the nervous system that it would be unsafe to consider them as idiopathic, even if not giving any clear manifestations of organic involvement of the nervous system. This would throw out all cases of alcoholism and other intoxications, such as Bright's disease, lead poisoning, syphilis, etc.

The methods used were the same as those mentioned in the following section for the "Study of the Blood with Relation to Seizures." The time when the blood was taken varied between 11 A.M. and 11.40 A.M. These are narrow limits of variation if it is considered that breakfast, the last meal preceding the withdrawal of the blood, was taken at 6 A.M.

The results are seen in the following table:

Men.			Women.		
Hæmoglobin percentage.	Erythrocytes per cubic mm.	Leukocytes per cub. mm.	Hæmoglobin percentage.	Erythrocytes per cubic mm.	Leukocytes per cub. mm.
104	5,088,000	7,111	100	4.288,000	10,711
105	5,152,000	6,222	101	5,440,000	8,000
108	5,696,000	6,777	100	4,880,000	7,466
109	6,054,000	9.022	90	4,416,000	7,066
106	5,456,000	8,352	103	5,376,000	8,888
106	5,616,000	6,355	100	5,152,000	6,977
103	4,992,000	8,755	100	5,024,000	8,533
105	5,184,000	9,816	102	5,264.000	9,822
			100	5,328,000	9,466
			94	4,264.000	9,822
			98	4,416,000	6,400
Averages.			Averages.		
106	5,405,000	7,802	97	4,895,000	8,468

This table shows for the men an unusually high average of erythrocytes, 5,405,000, which may perhaps be explained by the colony life. The hæmoglobin, taken with Dare's hæmoglobinometer, showed an average of 106, keeping thus pace with the erythrocytes, as shown by the color index, which is $\frac{98}{100}$. The leukocyte figures show nothing abnormal, the average being 7802.

The women show an average red-cell count of 4,895,000—*i. e.*, about as much lower than that of men, as is found in normal individuals. The hæmoglobin is diminished in proportion, the color index being $\frac{98}{100}$, just as in the men. The leukocyte count is not only relatively, but absolutely, higher yet within normal limits.

A perusal of the table shows that the hæmoglobin and erythrocyte figures vary within relatively narrow limits, especially in the men. This fact increases the value of the "average" figures. For the leukocytes the variation is considerably greater, but this is so normally also.

STUDY OF THE BLOOD WITH RELATION TO SEIZURES. These researches were conducted in such a manner as to fulfil all scientific requirements, taking account of the time of the day, the influence of meals, of fatigue and rest, change of habits, etc.

For the counts of the red cells Gowers' fluid was almost exclusively used and in every case two drops of the dilution mixture (1:200) were subjected to the count. In the counting of the leukocytes ½ per cent. acetic acid was used as a diluter.

The blood dilution employed for leukocyte counts was 1:20. The area counted was almost in all cases two square millimetres for each drop of diluted blood investigated, and two drops of the diluted blood were subjected to the count.

We abstain from a report of the differential leukocyte counts, as these still need revision.

Of the cases so far studied the research has been complete enough only in two to allow publication of the results. We, therefore, here confine ourselves to a report and discussion of these two cases.

SELECTION OF THE FIRST CASE. Keeping in mind the purposes outlined in a former paragraph we first endeavored to find a case that would allow us to distinctly compare the condition of the blood in the free intervals with that in and after seizures and if possible also directly before seizures.

For such a comparison cases with several attacks daily seemed unfit, as it was very likely that the two "phases," as we might say, would run into each other, become intermingled. A seizure would come on again before the blood had time to resume what for the patient in question was its normal condition. Even if this as a presumption was not *a priori* proven; the fact that it might be so made the selection of such a case undesirable. Even cases with one seizure every day or every other day seemed to offer the difficulties before mentioned, even although in much less degree. On the other hand, cases with too long intervals had the drawback of giving too few opportunities of studying the relation of the blood condition to the seizures. Therefore intervals averaging about a week seemed to meet requirements about the best. That cases with one single seizure at a time were to be preferred is evident from the foregoing. It was desirable furthermore to take a case with day seizures only, if possible, for a double reason: first, because the surveillance of the patient at night, owing to scarcity of attendants, was not close enough to be certain that a seizure was not overlooked and thus the result of the researches vitiated, and, second, because if a seizure occurred at night this would necessitate transferring the study of the case to the night—an inconvenience hardly needing discussion.

Last of all, the case was to be an idiopathic one for the beginning of the study at least. Later, organic ones could be included for comparison.

To make the selection, the seizure records of all patients of the Colony for the year 1904 were looked over with the kind help of Dr. Donald Ross, and it was surprising to see how the number of seemingly suitable cases became less and less in adaptation to the requirements made. The fact appeared, for instance, that not a single case was entirely free from night seizures, so that finally the choice dwindled down to one case, that of a colored boy who at least had only rare night seizures. A white patient would have been preferable, but none seemed to fill the requirements as well as the colored one. We say "seemed," since later observation made it appear very probable, if not certain, that the case was not one of uncomplicated idiopathic epilepsy, but was combined with hysteroepilepsy. As this discovery only appeared in the later course, however, when the study of the case was well under way, such was not interrupted and seemed to reveal some differences in the condition of the blood in the hysteroepileptic seizures from that of the epileptic one, although we admit that the number of seizures made to establish this difference was not large enough and not sufficiently unequivocal to allow of any far-going conclusions.

The very detailed and accurate history of the patient previous to the beginning of our blood examinations was kindly furnished us by Dr. Donald Ross, to whom we take occasion of expressing our gratitude for the same. While the patient was being studied by us we made clinical observations of our own and the notes recorded during that time are our own, with the exception of the report of a slight intervening illness which we again owe to Dr. Ross.

We subjoin here an abstract of the history, confining ourselves to the most important findings:

Case I.—Colored man, aged twenty years. No family history of epilepsy, chorea, alcoholism, or tuberculosis.

No convulsions as a child. First epileptic seizure at age of ten. No serious injury, although at age of three struck on forehead with a coffeepot. Fair progress at school. Seizures first chiefly at night at intervals of one or two months, several in succession; recently at intervals of about a week or two weeks and only in the day-time or mostly so. No outcry, no biting of tongue. Aura: feels nervous, shakes one or two hours before onset.

Physical examination reveals nothing abnormal on the part of the thoracic and abdominal organs, circulatory system, nor nervous system, except perhaps that patient shows a marked dermatographia as seen in a great number of epileptics.

Mental condition good for man of his education and race.

Admitted to the Colony on September 27, 1904. The number of seizures from the time of admission to the Colony September 27, 1904, to the time when the blood examinations were commenced—*i. e.*, November 16, 1904—was six. They were all grand-mal seizures and occurred four in October and two in November.

November 19*th. Abortive Seizure* (?). Between 1 and 1.30 P.M. patient was "dazed," and at 1.20 had about half a dozen general contractions, appearing like movements of being startled.

22*d*. Evidently a *grand-mal seizure*, observed by nurse during convulsive state; in the stertorous stage by Dr. Onuf. Had then foam at mouth; pupils contracted, without reaction. Breathing deeply stertorous.

23*d* at 9.42 P.M., *series of seizures, apparently hysteroepileptic.* Patient had within the last forty minutes about twenty attacks of the following kind, the description of which we here render in full.

First, a few twitchings or jerks usually in right arm, then a tonic contraction of neck and back muscles, leading to an opisthotonos attitude, and at the same time to rotation around the longitudinal axis of the body. At this stage one arm usually extended along the body, the other one strongly abducted—*i. e.*, having the opposite direction than that of the first one. Fingers clenched to fists, lower extremities extended. The rotation around the axis of the body in some seizures more than one revolution, in others one, one-half or so.

On reaching the abdominal position in this rotatory motion, the fist several times bumped the floor with considerable force. Head not injured. In some of the seizures a tonic contraction of the facial muscles on both sides, in others not, or at least not marked. Sometimes the rotation around the axis is to the right, in other seizures to the left.

Corneal reflex present all through a seizure and afterward. *Pupils* immediately after a seizure contracted, showing good reaction.

Knee-jerks during seizure not ascertainable owing to the rigidity of the lower extremities; directly after the seizure present on left, apparently absent on right side.

No stertorous stage after seizures, at the most one or two respirations of a stertorous character.

After the last seizure observed, patient regained consciousness very rapidly, almost instantaneously; recognized Drs. Donald Ross, Lograsso, and Onuf; knew where he was and remembered last action directly preceding the seizure.

At this stage no anæsthesia found anywhere, or at least no analgesia.

The seizures remained all purely tonic. No clonic stage. They bore resemblance to hysteroepileptic seizures more than having the character of grand-mal attacks. No foam at mouth. No sweating of forehead. Pulse during seizure was tense and full.

25*th*. *Grand-mal seizure* beginning at 5.25 P.M.—*i. e.*, five minutes after the blood was taken for examination. The description of this seizure, since it was observed by the writers, we here render in full:

A minute or so before it began, patient twice while sitting in a chair darted forward with a staring, absent look. This lasted every time a few seconds only. The actual grand-mal seizure began without a cry while sitting in the chair. Head was bent forward, upper and lower extremities semiflexed. The contractions were clonic almost throughout the attack. Hardly a tonic stage at all. Foam at the mouth. Forehead slightly moist. Pupils almost maximally dilated. Corneal reflex absent at end of attack and still immediately after.

The convulsive stage lasted five minutes. Stertorous stage not very deep. Clapping of hands suffices to make him open eyes. Breathing not typically stertorous, but more that of sound sleep. About ten minutes after onset of stertorous stage can be made to get up and walk around, but does so in a staggering manner like an intoxicated person. When asked what is the matter says, "I had an attack." Q. "How do you know?" A. "I felt it coming; had a feeling about the heart as if I was 'scared.'" After walking a few steps, lays head on a table.

Knee-jerks immediately after convulsive stage absent.

December 1, 1904, 4.30 P.M. *Mental disturbance, apparently a psychic epileptic equivalent.* He left work and ran across an almost dried canal with coat, vest, and suspenders off and about to unbutton his shirt. Asked what was the matter he said, "I want to go home." When asked where he was, he smiled.

5th. Seizure evidently grand mal, at 9.45 A.M., forty-five minutes after blood was taken for examination. This seizure was seen only in the postconvulsive stage by one of the writers. This stage, however, bore the character of the stertorous stage of the epileptic attack, and the description of the convulsions given by the nurse who observed it, also conformed to that of a grand-mal seizure, of which we omit a detailed account.

On that day and the second day following, the patient had an affection manifested by a dry, hacking cough, and a few mucous rales, pains in chest, headache, and a slight rise in temperature.

11th. Possible abortive seizure. Consisting in pain about umbilicus, soon extending to epigastrium; then palpitation and twitchings of the arms and legs. Pain lasted a few seconds, palpitation about an hour. Evacuation of bowels just after pain. Claims to have such an evacuation before each attack.

21st. Seizure of unknown nature while at neighboring village of Mount Morris.

24th. Blood examinations discontinued, the last one made yesterday.

January 3 (or 2?), 1905. *Four seizures, probably hysteroepileptic in nature.* Described by the man in charge of the laundry as follows:

Patient twisted himself around, lying once on his "belly," then again on his back, kicked around with his hands and feet in different ways and very violently; did not hurt himself. Had no foam at mouth; was not cyanotic. Each seizure lasted several minutes. After the last one he got up at once, showing no unsteadiness of gait.

4th. About 2.22 P.M. *Grand-mal seizure.* Seen by the writers and reported by Dr. Lograsso.

At about 2.10 P.M. he told me that he was to have a seizure, and on enquiry how he knew he could not explain any more than to say that he felt nervous, and that he was having twitchings of both arms and legs. He looked pale and his eyes very glaring. His pulse was rapid, about 110 per minute, but full and bounding. Just about five minutes before the attack I observed a twitching of both his arms, followed immediately by the twitching of both legs. He had three of these twitchings with a short interval between (about one minute). The last twitching was followed immediately by a "Doctor, doctor," when I observed first his clutching of the hands and his stooping forward on his chair. The clutching was followed by tonic flexion of his forearms, fists pointing toward each other, flexion of his legs, and, to my recollection, also flexion of feet. The whole body was now in a state of tonic contraction. This lasted but a very short time, about one minute, when he passed into a state of clonic contractions of the whole body. The lower jaw was moving up and down very rapidly, he giving a grunt here and there.

During the clonic stage he had foam at the mouth; pupils were dilated, and the corneal reflex absent. There was marked cyanosis of his lips and fingers and throbbing of the carotids. The stage lasted about three minutes in all and was followed by a stertorous state from which he was not very easily aroused by the pricking with a pin. On being aroused and on being asked questions he answered, but his words were indistinct, thick, so that it was hard to make out what he said.

A circumstance not mentioned by us before was the appearance during the convulsive state of a circumscribed erythema of both temples, reaching forward to the external canthus, occupying altogether an area about the size of a palm on each side, and quite symmetrical.

27th. In view of the fact that patient had a number of seizures very suggestive of hysteroepileptic seizures, a thorough examination for hysterical stigmata was made to-day with the following result:

Sensation. Tactile, pain, and temperature sense absolutely undisturbed everywhere except perhaps in an area about the size of a quarter, over both the Achilles tendons, where he does not perceive touching with a piece of cotton. However, as this area is slightly callous, this may account for the disturbance. Muscular sense perfect everywhere.

Vision. No contraction of visual fields, and vision corrected by glasses is $\frac{15}{15}$ on either eye.

Hearing. Greatly diminished on both ears. Hears a watch at distance of about a quarter of an inch from each ear. Normally this watch is heard at about two feet distance from ear. Drums show nothing abnormal.

Smell. Evidently unimpaired on both sides; readily distinguishes camphor, ammonia, and peppermint, but not oil of cinnamon and oil of cloves; probably does not know oil of cloves, and the smell of the oil of cinnamon used for the test was not characteristic.

Taste. Well preserved on entire tongue.

DIAGNOSIS. It results from this examination that there is only one point that might eventually be taken for a stigma of hysteria, namely, the diminution of hearing, which finds no proper explanation in the result of the otological examination and history, and may therefore be a functional one, although it would be risky to state this as a positive fact.

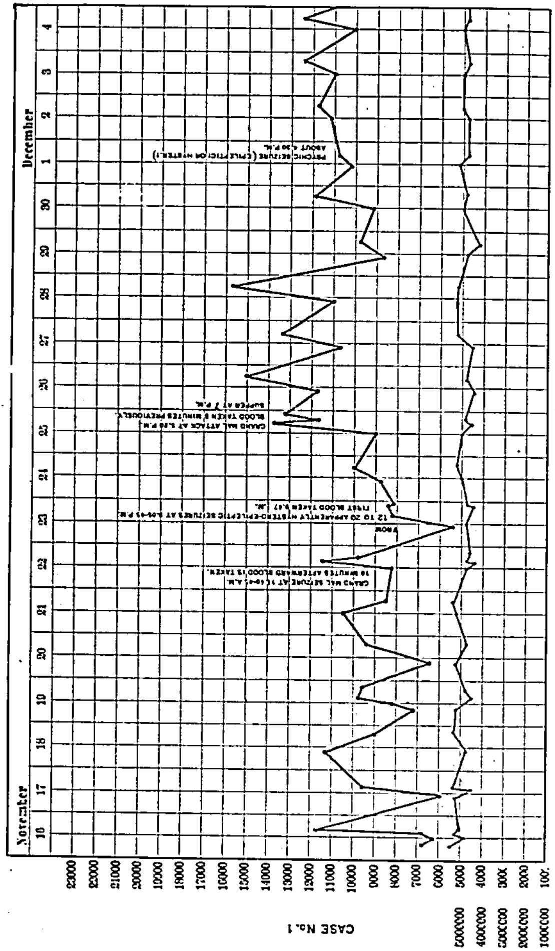
The case, therefore, presents nothing on which to base the complication with hysteria except the nature of some of the seizures. The great number of seizures in a short space of time; the presence of the corneal reflexes during the seizures; the absence of cyanosis, of perspiration, and foam at mouth during the seizure; the absence of the clonic stage; the rapidity with which consciousness was regained, and the practical absence of the stertorous stage are points much in favor of the hysteroepileptic nature of the seizures if contrasted with the grand-mal seizures observed in patients, which were attended by a well-pronounced clonic stage, by cyanosis, foam at mouth, considerable perspiration, and a well-marked stertorous stage followed up by symptoms, which reminded one so much of alcoholic intoxication: the staggering gait, the thick speech, and the marked somnolence.

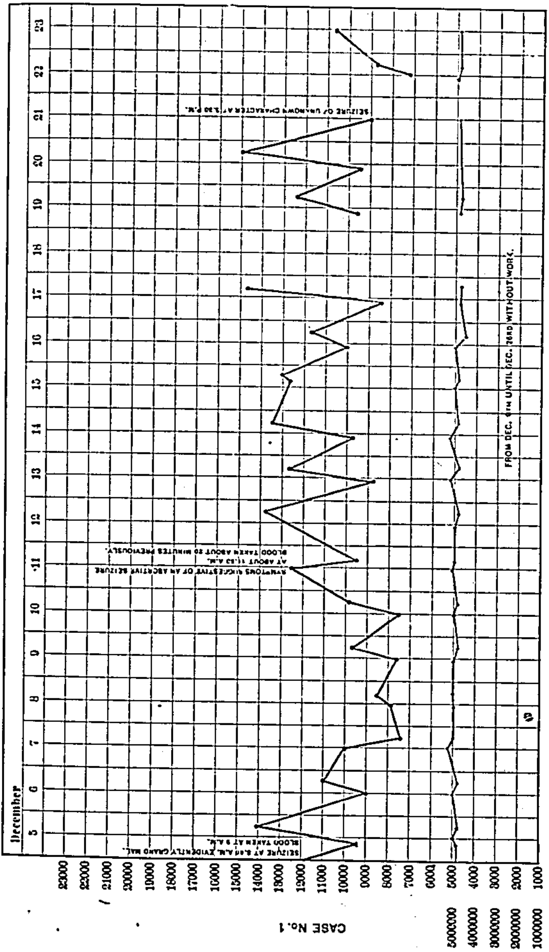
We are aware, of course, that in petit-mal seizures many of the features just mentioned could also be absent, but seizures bearing the hysteroepileptic character described differ too much from petit mal to be mistaken for such.

BLOOD EXAMINATIONS OF CASE I. As we already mentioned, blood examinations of Case I. were made twice daily from November 16th to December 23d, and were not interrupted except on December 18th. The examinations were almost all made at the same time, namely, 11.30 or thereabouts, half an hour before lunch, and 5.30 P.M., or very near that time—*i. e.*, from half an hour to one hour before supper. While it might have been advisable to examine before breakfast, this proved practically too difficult to accomplish. When seizures occurred examinations were, furthermore, made during such and at certain intervals after.

The results were recorded in a chart which is here reproduced. The curve for the red cells is rendered by the upper, *i. e.*, heavier line; that for the white corpuscles by the lower, *i. e.*, lighter line. The faint vertical lines represent hours. (For further details see the explanations accompanying the chart.)

On discussing the chart we mention first that the behavior of the erythrocytes offered nothing characteristic or definite. We therefore abstain from conclusions regarding them and simply refer the reader to the chart for their numerical study.


CASE No. 1
November
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
December
1
2
3
4
23000
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
5000000
4000000
3000000
2000000
1000000
GRAND MAL SEIZURE AT 11.40-45 A.M.
10 MINUTES AFTERWARD BLOOD IS TAKEN.
FROM
12 TO 20 APPARENTLY HYSTERO-EPILEPTIC SEIZURES AT 9.05-45 P.M.
FIRST BLOOD TAKEN 9.47 P.M.
GRAND MAL ATTACK AT 5.20 P.M.
BLOOD TAKEN 5 MINUTES PREVIOUSLY.
SUPPER AT 7 P.M.
PSYCHIC SEIZURE (EPILEPTIC OR HYSTER.?)
ABOUT 4.30 P.M.


CASE No. 1
December
5
6
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8
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11
12
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15
16
17
18
19
20
21
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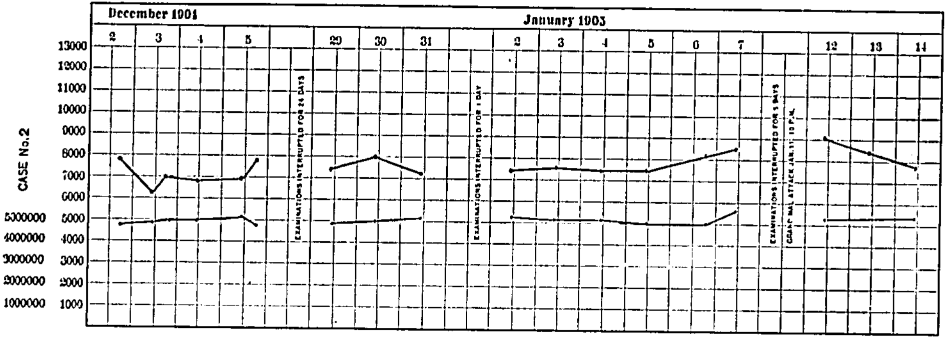
23
23000
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
5000000
4000000
3000000
2000000
1000000
SEIZURE AT 8.40 A.M. EVIDENTLY GRAND MAL.
BLOOD TAKEN AT 9 A.M.
SYMPTOMS SUGGESTIVE OF AN ABORTIVE SEIZURE
AT ABOUT 11.53 A.M.
BLOOD TAKEN ABOUT 20 MINUTES PREVIOUSLY.
SEIZURE OF UNKNOWN CHARACTER AT 3.30 P.M.
FROM DEC. 6TH UNTIL DEC. 23RD WITHOUT WORK.


December 1904
January 1905
2
3
4
5
29
30
31
2
3
4
5
6
7
12
13
14
EXAMINATIONS INTERRUPTED FOR 24 DAYS
EXAMINATIONS INTERRUPTED FOR 1 DAY
EXAMINATIONS INTERRUPTED FOR 5 DAYS
GRAND MAL ATTACK JAN. 11. 10 P.M.
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
5000000
4000000
3000000
2000000
1000000
CASE No. 2

On the other hand, interesting observations were made on the leukocytes which we shall here discuss.

Leukocytes. The most marked feature concerning the leukocytes is the fluctuation in the leukocyte count. The lowest figure is seen November 23d at 11.30 A.M., namely, 5333;[1] the highest one November 28th, 5.15 P.M., namely, 15,800; or, in other words, the maximum figure is almost three times as high as the minimum one.

The fluctuations are of two kinds, namely, first, daily fluctuations, and second, ascents and descents extending over longer periods. As to the daily fluctuations we see that as a rule the count taken before lunch is lower than the one taken before supper, but there are four exceptions to this rule, namely, on November 18th and 21st and December 7th and 11th, on which days the morning count was higher than the evening count. *This already indicates that the fluctuations in the leukocyte count cannot be explained purely by the daily influence of meals, work, and sleep, but that some additional factors must be at work to produce them. This conclusion is confirmed by making a further study of the chart, which reveals the presence of elevations and depressions extending over longer periods.* For instance, an elevation is seen to extend from November 23d at noon—*i. e.*, 11.30—to November 29th, 11.30 A.M., or over six days, with well-marked peaks on November 25th, 5.20 P.M., and November 26th, 5 P.M., and some lesser ones. Another elevation reaches from November 29th, 11.30 A.M., to December 7th, 11.15 A.M., and a third one from there to December 17th.

If we now study the relation of the seizures to the leukocyte counts we find the following:

There are three grand-mal seizures recorded during the period of blood examinations. As good luck would have it, it happened with two seizures that the blood had been taken shortly before the occurrence of the same—*i. e.*, on November 22d, ten minutes before a grand-mal seizure, and on November 25th, five minutes before a grand-mal attack.

The result of the blood examination differed for the two attacks. On November 22d the count taken directly before the seizure was 8154, or relatively low; on November 25th, the count taken directly

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[1] Per cubic millimetre.

EXPLANATION OF CHARTS.

The distances between the vertical lines of the charts represent twelve hours, so that in Case No. 1 the vertical line under (November) 16 represents noon, that between (November) 16 and 17 midnight, etc. In the original charts each hour of the day was represented by a vertical line. Owing to great reduction in size, however, these lines had to be left out on the plates. But the time of the day of each examination recorded in the charts is indicated by the distance from the nearest "noon"—and "midnight"—lines.

The figures from 1000 to 25,000 represent the number of leukocytes, those from 1,000,000 to 5,000,000 the number of erythrocytes.

The heavier, upper line registers the leukocytes; the lighter, lower line the red cells.

before the seizure was 13,888—*i. e.*, apparently high, representing a distinct leukocytosis.

These two observations show two facts: *First, that a leukocytosis may already be present directly before a seizure, and, if so, is then of course not a purely secondary phenomenon produced by the seizure. The second fact brought out is that a grand-mal seizure need not necessarily be preceded or ushered in by a leukocytosis.*

The third grand-mal seizure falling into the period of the blood examinations occurred on December 5th. Here the blood was taken twenty minutes after the onset of the seizure.

The behavior of the leukocytes after the onset of the seizure differs in the three grand-mal attacks studied; in the one occurring November 22d the number of leukocytes rose after the onset of the seizure, reaching its maximum in two hours or possibly somewhat later. In the seizure occurring November 25th the maximum count had been reached directly before the seizure—13,888—after which, within one hour and forty minutes, it had fallen to 11,800, to rise again within the next three hours up to 13,177, a meal having intervened in the mean time, by which this latter rise could be explained. In the third attack, December 5th, the leukocyte count rose for approximately eight hours after the onset of the seizure. The exact time at which the maximum occurred cannot be stated, as the number of examinations made was not sufficient to exactly state that period.

These observations certainly teach the important fact that there is no absolute parallelism between seizure and leukocytosis in so far as, even when a distinct leukocytosis is present, such may reach its height at different periods in different seizures; they also show that the leukocytosis is, in part at least, independent of the seizure.

The study of the chart further teaches that the marked elevations of the curve do not necessarily mean seizures. This is illustrated by the high evening counts of November 16th and 18th, still more of November 26th and 28th, etc.

Of interest is the fact that the seizure of November 25th was ushered in by a gradual steady climb of the leukocyte count extending over fifty-three hours. But on the other hand no distinct "incubation climb," as we might call it, was observed to precede the grand-mal attacks of November 22d and December 5th.

A further notable fact is the one that the blood taken at the end of the series of hysteroepileptic seizures occurring November 23d showed no leukocytosis, the count being 8288. Neither was such present an hour and thirty minutes afterward.

It seemed to us as if the principal fact that had been brought out by the investigations of this case was the great fluctuation of the leukocyte count. It seemed important to find out whether this fluctuation had anything to do with the epileptic state or whether it was accidental. It seemed therefore desirable to find out whether such fluctuations occurred also in normal persons and in epileptics who had their seizures at larger intervals. We began the study with a case of the latter kind—*i. e.*, of an intelligent patient affected with idiopathic epilepsy (R.Cl.) whose seizures occurred one every two or three months. The chart of this case (No. 2.) is very instructive.

In the first four days the leukocyte count showed slight fluctuations—*i. e.*, between about 6133 and 7866. The examinations were interrupted on December 5th and resumed December 29th. From that date the leukocyte curve ran very evenly, varying only about 200 leukocytes, until January 5th and 6th, when a distinct rise occurred which reached its maximum of 8755 on January 7th, so far as the examinations went, which unfortunately were then interrupted. On January 11th patient had a seizure. The first examination after this seizure was made January 12th, revealing the highest leukocyte count so far obtained—*i. e.*, 9066. The curve certainly suggests that in the intervening days the count was still higher.

The case, in spite of this unfortunate break in the curve, is very instructive and deserving of further study. It tends to show or to foreshadow that where the intervals between the seizures are long, the fluctuations of the leukocyte count are apt to be slight and to concentrate around the period of seizures, and that the curve is apt to be an almost entirely even one in most of the time of the free interval.

GUNSHOT WOUNDS OF THE ABDOMEN.

A REVIEW OF FOURTEEN CASES, WITH REMARKS ON THE MORTALITY AND TREATMENT.[1]

By George Tully Vaughan, M.D.,
WASHINGTON, D. C.

In my series of 14 cases suffering with gunshot wounds of the peritoneal cavity there were 8 cases of wound of the small intestine, 6 of the large intestine (5 of the colon and 1 of the rectum), 5 of the diaphragm and pleura, 5 of the liver, 2 of the stomach, and 2 of the kidneys. Several patients had a number of wounds in one organ, while in others several organs were wounded; for example, one patient had eleven bullet holes in the intestine, while another had perforation of the liver, stomach, and colon.

One of the patients was not operated on, 1 was operated on late,

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[1] Read at the meeting of the Association of Military Surgeons of the United States at Detroit, Mich., September 26–29, 1905.